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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/714,230	11/14/2003	Sam-Shajing Sun	036021.0001	2469
22467 Kimberly A. Chasteen PO Box 1243 Yorktown, VA 23692	7590 08/14/2008			
EXAMINER				
MOWLA, GOLAM				
ART UNIT		PAPER NUMBER		
1795				
MAIL DATE		DELIVERY MODE		
08/14/2008		PAPER		

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

### Office Action Summary

**Application No.**

10/714,230

**Applicant(s)**

SUN, SAM-SHAJING

**Examiner**

GOLAM MOWLA

**Art Unit**

1795

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 01 May 2008.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 9-26 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 9-26 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SF/ICE)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Response to Amendment***

1. Applicant's amendment of 05/01/2008 does not render the case allowable.
2. Claims 9-26 are pending. Applicant has cancelled claims 1-8 and amended claims 9 and 26.

### ***Status of the Rejections***

3. The rejection of claims from the office Action mailed on 01/04/2008 are withdrawn. New ground(s) of rejection under 35 U.S.C. 103 is/are presented.

### ***Priority***

4. Acknowledgement is made of Applicant's claim for domestic priority of Provisional Application No. 60/426,108, filed on 11/14/2002, under 35 U.S.C. 119(e), which papers have been placed of record in the file.

However, the provisional application does not provide support for "dissolving the photovoltaic block copolymer samples in a solvent and filtering the copolymer-solvent mixture, ..., removing the solvent" (as claimed in claim 9), "immersing a portion of a piece of conducting glass in a concentrated sulfuric acid cleaning solution; cleaning the entire piece of conducting glass; spin coating the piece of conducting glass with the photovoltaic block copolymer to form a film having a thickness of about 100 nm; and vacuum depositing an electrode material on top of the film wherein the electrode

material has a thickness of about 100 nm, such that a positive electrode and a negative electrode are formed" (as claimed in claim 18), and "providing a substrate having a conducting layer; removing the conducting layer from a portion of the substrate; cleaning the substrate using a cleaning solution; spin coating the photovoltaic block copolymer onto the substrate to form a film; and vacuum depositing an electrode material on top of the film, such that a positive electrode and a negative electrode are formed" (as claimed in claim 22). In addition, the provisional application also does not provide support for most of the dependent claims, specifically claims 12-17, 19-20 and 23. Therefore, the effective filing date of pending claims 9-26 is 11/14/2003.

***Publication Date of Non-Patent Literature***

5. Examiner notes that the original publication date of "Synthesis and Characterization of a Novel Block Copolymer containing donor and acceptor blocks" to Fan et al. is 01/2001. The article was published by NASA Center for Materials Research on 01/2001 (see <http://adsabs.harvard.edu/abs/2001STIN...0316552F>).

***Claim Rejections - 35 USC § 102***

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 9-16 and 25-26 are rejected under 35 U.S.C. 102(b) as being anticipated by Fan et al. ("Synthesis and Characterization of a Novel Block Copolymer containing donor and acceptor blocks," NASA Publication, 01/2001).

Regarding claim 9, Fan discloses a method for forming an organic photovoltaic device, comprising:

- synthesizing photovoltaic conjugated block copolymer samples ((B-A-B-D)<sub>n</sub> type conjugated block copolymer system; see Experimental, and Conclusion);
- dissolving the photovoltaic block copolymer samples in a solvent (polar aprotic solvent such as dichloromethane; see Experimental);
- filtering the copolymer-solvent mixture (Experimental);
- forming a film of the copolymer-solvent mixture on a pretreated glass slide/prepared surface (see Experimental);
- removing the solvent (the films were dried overnight in heated vacuum; see Experimental).

With respect to claim 10, Fan further teaches that the photovoltaic block copolymer ((B-A-B-D)<sub>n</sub>) samples are synthesized by:

- individually synthesizing conjugated donor chains (see fig. 1 in which Donor Block D is synthesized first and then added to the Bridge Block B and ), conjugated acceptor chains (Acceptor Block A; see fig. 1), and non-conjugated bridge chains (Bridge Block B; Figure 1);

- combining the non-conjugated bridge chains (B) with the conjugated donor chains (D) to form a plurality of bridge-donor-bridge units (B-D-B; see scheme b in fig. 1; see also conclusion); and
- combining the bridge-donor-bridge (B-D-B) units with the conjugated acceptor chains (A) (see scheme b in fig. 1).

With respect to claim 11, Fan further discloses the photovoltaic block copolymer samples ((B-A-B-D)<sub>n</sub>) are synthesized by:

- individually synthesizing conjugated donor chains (see fig. 1 in which Donor Block D is synthesized first and then added to the Bridge Block B and ), conjugated acceptor chains (Acceptor Block A; see fig. 1), and non-conjugated bridge chains (Bridge Block B; Figure 1);
- combining the non-conjugated bridge chains (B) with the conjugated acceptor chains (A) to form a plurality of bridge-acceptor-bridge units (B-A-B; see scheme a in fig. 1; see also conclusion); and
- combining the bridge-acceptor-bridge units (B-A-B) with the conjugated donor chains (D) (see scheme a in fig. 1).

With respect to claim 12, Fan further discloses the solvent is removed by drying (dried overnight in the heated vacuum oven; see Experimental).

With respect to claim 13, Fan further discloses that the copolymer-solvent solution is filtered using a filter having a pore size of about 0.2 microns (see Experimental).

With respect to claim 14, Fan further discloses that the film is formed by a method selected from the group consisting of spin coating and drop drying (see Experimental).

With respect to claim 15, Fan further discloses that the prepared surface is pre-cleaned (conducting glass/pretreated glass slides; see Experimental).

With respect to claim 16, Fan further discloses that the solvent is removed by heating (in a heated vacuum; see Experimental).

With respect to claim 25, Fan further teaches that the photovoltaic block copolymer ((B-A-B-D)<sub>n</sub>) samples are synthesized by:

- individually synthesizing conjugated donor chains (see fig. 1 in which Donor Block D is synthesized first and then added to the Bridge Block B and ), conjugated acceptor chains (Acceptor Block A; see fig. 1), and non-conjugated bridge chains (Bridge Block B; Figure 1);
- combining the non-conjugated bridge chains (B) with the conjugated donor chains (D) to form a bridge-donor-bridge unit (B-D-B; see scheme b in fig. 1; see also conclusion); and
- forming a second unit -(B-D-B-A)-; see scheme b in fig. 1) by combining one conjugated acceptor chains (A) (see scheme b in fig. 1) with the first unit at a non-conjugated bridge chain (see scheme b in fig. 1).

With respect to claim 26, Fan further discloses the photovoltaic block copolymer samples ((B-A-B-D)<sub>n</sub>) are synthesized by:

- individually synthesizing conjugated donor chains (see fig. 1 in which Donor Block D is synthesized first and then added to the Bridge Block B and ), conjugated acceptor chains (Acceptor Block A; see fig. 1), and non-conjugated bridge chains (Bridge Block B; Figure 1);
- combining the non-conjugated bridge chains (B) with the conjugated acceptor chains (A) to form a bridge-acceptor-bridge unit (B-A-B; see scheme a in fig. 1; see also conclusion); and
- forming a second unit -(B-A-B-D)-; see scheme a in fig. 1) by combining one conjugated donor chains (D) (see scheme a in fig. 1) with the first unit at a non-conjugated bridge chain (see scheme a in fig. 1).

### ***Claim Rejections - 35 USC § 103***

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

9. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

10. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Fan as applied to claim 9 above, and further in view of Allen et al. ( US 5041510, Cited in previous office action).

Applicant is directed above for complete discussion of Fan with respect to claim 9. Fan further discloses heating the device subsequent to removing the solvent (thermal analyses; see experimental section). However, Fan fails to disclose applying to the device a force selected from the group consisting of magnetic, electrical, and optical forces.

Allen discloses the processing of copolymer block film (col.6; lines15-24) and discloses applying a force to polymer selected from the group consisting of magnetic and electrical (col.3; lines 66-68 & col.4; lines 1-2) forces to induce alignment of mobile dipolar copolymers (col. 3; lines 66-68).

It would have been obvious to one skilled in the art at the time of the invention to apply magnetic or electrical forces as taught by Allen to modify Fan et al. in order to mobilize the dipolar (charge carriers within) copolymers.

11. Claims 18-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bailey et al. ("Thin-film organic-based solar cells for space power", NASA publication, 01/2001) in view of Leslie et al. (US 4869847) and Snelling (US 5563687).

With respect to claim 18, Bailey teaches a method for forming an organic photovoltaic device (fullerene-containing polymeric device; right col., page 20154-4), comprising:

- providing a piece of conducting glass (ITO-coated glass; right col., page 20154-5);
- spin coating the piece of conducting glass with the photovoltaic film (MEH-PPV:PCBM) having a thickness of about 100nm (600-800 angstrom; left col., page 20154-5); and
- depositing an electrode material (Al; left col., page 20154-5) on top of the film wherein the electrode material has a thickness of about 100nm (metal layers each 1000 angstrom thick; left col., page 20154-5), such that a positive electrode (ITO-coated glass) and a negative electrode (Al) are formed.

Although the specific example does not disclose synthesizing a photovoltaic block copolymer from conjugated donor chains, conjugated acceptor chains and non-conjugated bridge chains, the reference teaches synthesis of such photovoltaic block copolymer from conjugated donor chains, conjugated acceptor chains and non-conjugated bridge chains (see page 20154-3, right col. to page 20154-4, left col.) which can be used in the photovoltaic device. The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See MPEP § 2144.07.

Examiner notes that the use of photovoltaic block copolymer synthesized from conjugated donor chains, conjugated acceptor chains and non-conjugated bridge chains in place of MEH-PPV:PCBM blends will change the thickness of the film. However,

"where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation." See *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955). See also MPEP § 2144.05 – IIA. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to have optimized the film thickness to about 100 thickness by routine experimentation as desired by Bailey.

However, the reference is silent as to the step of immersing a portion of a piece of conducting glass in a concentrated sulfuric acid cleaning solution; and cleaning the entire piece of conducting glass.

Leslie teaches a conductive glass which is made of ITO (see example 1 on col. 4-5) is immersed in a concentrated sulfuric acid cleaning solution and the entire piece of conductive glass is cleaned (see col. 4, line 67 to col. 5, line 9).

It would have been obvious to one of ordinary skill in the art to have immersed a portion of a piece of conducting glass of Bailey in a concentrated sulfuric acid cleaning solution and clean the entire piece of conducting glass, because such use of concentrated sulfuric acid cleaning solution to clean conducting glass is conventional in the art as shown by Leslie.

The reference is also silent as to whether the Al electrode is vacuum deposited on the film.

One of ordinary skill in the art would have realized that the vacuum disposition is a known method to deposit an electrode layer onto another layer or film of a device. Snelling discloses the use of vacuum disposition to form Al electrode on the photoactive

layer (3) (see fig. 1; col. 3, lines 16-19). Snelling utilizes vacuum deposition to deposit Al electrode on the photoactive layer because such use of the vacuum deposition is conventional in the photovoltaic art to deposit the electrode layer on the photoactive layer.

It would have been obvious to one of ordinary skill in the art to have deposited the electrode layer of Bailey on the film by vacuum disposition as taught by Snelling because such use of the vacuum deposition is conventional in the photovoltaic art to deposit the electrode layer on the photoactive layer as shown by Snelling.

With respect to claims 19 and 20, the method further comprises forming one film of carrier collection material such as lithium fluoride between the photovoltaic block copolymer and the electrodes (see left col., page 20154-5).

12. Claims 22-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bailey in view of Leslie and Snelling. Supporting evidence is provided by Kittler et al. (US 4937055).

With respect to claim 22, Bailey teaches a method for forming an organic photovoltaic device (fullerene-containing polymeric device; right col., page 20154-4), comprising:

- providing a substrate (glass substrate) having a conducting layer (ITO layer) (ITO-coated glass; right col., page 20154-5);
- spin coating the piece of conducting glass with the photovoltaic film (MEH-PPV:PCBM) onto the substrate to form a film; and

- depositing an electrode material (Al; left col., page 20154-5) on top of the film, such that a positive electrode (ITO-coated glass) and a negative electrode (Al) are formed.

Although the specific example does not disclose synthesizing a photovoltaic block copolymer from conjugated donor chains, conjugated acceptor chains and non-conjugated bridge chains, the reference teaches synthesis of such photovoltaic block copolymer from conjugated donor chains, conjugated acceptor chains and non-conjugated bridge chains (see page 20154-3, right col. to page 20154-4, left col.) which can be used in the photovoltaic device. The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). See MPEP § 2144.07.

However, the reference is silent as to the step of removing the conducting layer from a portion of the substrate and cleaning the substrate using a cleaning solution.

Leslie teaches a conductive ITO-coated glass (see example 1 on col. 4-5) is immersed in a concentrated sulfuric acid cleaning solution and the entire piece of conductive glass is cleaned (see col. 4, line 67 to col. 5, line 9). Leslie further teaches that the ITO-coated glass is cleaned for 2 minutes (see col. 4, line 67 to col. 5, line 9), which inherently etches or removes a portion of the ITO conductive layer (see US 4937055, example 6 on col. 7, lines 1-13).

It would have been obvious to one of ordinary skill in the art at the time of the invention to have utilized the cleaned the substrate of Bailey using the cleaning solution

of Leslie which would subsequently remove a portion of the conductive layer, because such use of cleaning solution to clean substrate and remove a portion of the conducting layer is conventional in the art as shown by Leslie.

The reference is also silent as to whether the Al electrode is vacuum deposited on the film.

One of ordinary skill in the art would have realized that the vacuum disposition is a known method to deposit an electrode layer onto another layer or film of a device. Snelling discloses the use of vacuum disposition to form Al electrode on the photoactive layer (3) (see fig. 1; col. 3, lines 16-19). Snelling utilizes vacuum deposition to deposit Al electrode on the photoactive layer because such use of the vacuum deposition is conventional in the photovoltaic art to deposit the electrode layer on the photoactive layer.

It would have been obvious to one of ordinary skill in the art to have deposited the electrode layer of Bailey on the film by vacuum disposition as taught by Snelling because such use of the vacuum deposition is conventional in the photovoltaic art to deposit the electrode layer on the photoactive layer as shown by Snelling.

With respect to claim 23, the method further comprises forming one film of carrier collection material such as lithium fluoride between the photovoltaic block copolymer and the electrodes (see left col., page 20154-5).

13. Claims 21 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bailey in view of Leslie as applied to claim 18 and 22, and further in view of Thompson et al. (US PGPUB 2002/0034656).

Applicant is directed above for complete discussion of a method of forming an organic photovoltaic device as discussed for claims 18 and 22 in view of Bailey, Leslie and Snelling with supporting evidence provided by Kittler. Examiner notes that the photovoltaic block copolymer functions as photovoltaic layer. However, the references are silent as to forming a film synthesized from donor chains between the positive electrode and the photovoltaic block copolymer, and forming a film synthesized from acceptor chains between the negative electrode and the photovoltaic block copolymer.

Thompson teaches forming of a film synthesized from donor chains (hole transport material,  $\alpha$ -NPD; see fig. 7, example 1 and 2; ¶ [0154-0160]) between the positive electrode (ITO; see fig. 7 and [0160]) and the photovoltaic active layer ( $\text{Ir(ppy)}_3$  in CBP; see fig. 7 and [0160]), and forming a film synthesized from acceptor chains (electron transport layer Alq3; fig. 7 and [0160]) between the negative electrode (Ag; see [0155]) and the photovoltaic layer ( $\text{Ir(ppy)}_3$  in CBP; see fig. 7 and [0160]). Thompson forms a donor film synthesized from donor chains between the positive electrode and the photovoltaic layer because it allows to transport holes to the photoactive layer and forms a film synthesized from acceptor chains between the negative electrode and the photovoltaic layer because it allows transport electron into photoactive layer and to reduce light absorption at the cathode (see [0160]).

It would have been obvious to one of ordinary skill in the art the time of the invention to have formed a film synthesized from donor chains between the positive electrode and the photovoltaic layer and to have formed a film synthesized from acceptor chains between the negative electrode and the photovoltaic layer in the modified method of Bailey, because such use of donor film allows the device to transport holes to the photoactive layer and such use of acceptor film allows the device to transport electron into photoactive layer and to reduce light absorption at the cathode, as taught by Thompson.

### ***Response to Arguments***

14. Applicant's arguments with respect to claims 9-26 have been considered but are moot in view of the new ground(s) of rejection.

#### **Claim Rejections under 35 U.S.C. § 103 (a)**

##### **Claims 9-17 and 25-26**

Applicant argues that "Thompson fails to disclose photovoltaic conjugated block copolymers" (see Remarks, page 11).

The argument is moot in view of new ground(s) of rejection as required by Applicant's amendment of claim 9 (see above for rejection of claims 9-17 and 25-26 under 35. U.S.C. 102/103 in view of Fan and Allen).

##### **Claims 18-24**

Applicant argues that "Brabec fails to disclose synthesizing a photovoltaic block copolymer from conjugated donor chains and non-conjugated bridge chains" (see Remarks, page 11).

The argument is persuasive. However, upon consideration a new ground(s) of rejection is/are provided above under 35. U.S.C. 103 in view of Bailey, Leslie, Snelling, and Thompson (see above).

#### ***Correspondence/Contact Information***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to GOLAM MOWLA whose telephone number is (571) 270-5268. The examiner can normally be reached on M-F, 0900-1700 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, ALEXA NECKEL can be reached on (571) 272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a

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USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/G. M./

Examiner, Art Unit 1795

/Alexa D. Neckel/

Supervisory Patent Examiner, Art Unit 1795